I, Tadahiko Itoh, a Patent Attorney of Tokyo, Japan having my office at 32nd Floor, Yebisu Garden Place Tower, 20-3 Ebisu 4-Chome, Shibuya-Ku, Tokyo 150-6032, Japan do solemnly and sincerely declare that I am the translator of the attached English language translation and certify that the attached English language translation is a correct, true and faithful translation of Japanese Patent Application No. 10-124748 to the best of my knowledge and belief.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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(Document Name)	Specification 1
(Document Name)	Drawing 1
(Document Name)	Abstract 1

[Name of the Document] Specification

[Title of the Invention]

SIGNAL TRANSMITTING METHOD, SPREADING CODE ASSIGNING METHOD, BASE STATION, AND MOBILE STATION IN DIRECT-SEQUENCE CDMA MOBILE COMMUNICATION SYSTEM

[Claims]

[Claim 1]

A signal transmitting method in a direct sequence CDMA mobile communication system for transmitting a signal after spreading said signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, said first spreading code having the same repetition period as an information symbol period, said second spreading code having a longer repetition period than the information symbol period, said first spreading code and said second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of said spreading codes being higher than an information rate; wherein

said second spreading code is associated with a mobile communication system; and

a base station transmits a signal spread by said second spreading code associated with a mobile communication system to which the base station belongs.

[Claim 2]

The signal transmitting method in a direct sequence CDMA mobile communication system as claimed in claim 1, wherein instead of a second spreading code associated with a mobile communication system, a second spreading code associated with a network type to which said mobile communication system belongs is used as said second spreading code.

[Claim 3]

A spreading code assigning method in a direct sequence CDMA mobile communication system for transmitting a signal after spreading said signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, said first spreading code having the same repetition period as an information symbol period, said second spreading code having a longer repetition period than the information symbol period, said first spreading code and said second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of said spreading codes being higher than an information rate, said method comprising the step of:

assigning a code associated with a mobile communication system or a network type to which said mobile communication system belongs as said second spreading code.

[Claim 4]

A base station in a direct sequence CDMA mobile communication system for transmitting a signal after spreading said signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, said first spreading code having the same repetition period as an information symbol period, said second spreading code having a longer repetition period than the information symbol period, said first spreading code and said second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of said spreading codes being higher than an information rate; wherein

said second spreading code is associated with a mobile communication system or a network type to which said mobile

communication system belongs; and

the base station is configured to transmit a signal spread by said second spreading code associated with a mobile communication system to which the base station belongs or by said second spreading code associated with a network type to which said mobile communication system belongs.

[Claim 5]

A mobile station in a direct sequence CDMA mobile communication system for receiving a signal transmitted from the base station by the signal transmitting method in the direct sequence CDMA mobile communication system as claimed in claim 1 or 2;

wherein the mobile station includes said second spreading code associated with one or more mobile communication systems or said second spreading code associated with a network type to which said one or more mobile communication systems belong, and is configured to receive the signal transmitted from the base station by using said second spreading code.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a signal transmitting method, a spreading code assigning method, a base station, and a mobile station in a direct-sequence CDMA mobile communication system.

[0002]

[Prior Art]

Generally, in a direct sequence CDMA (code division multiple access) system, a first spreading code group, common to base stations which have the same repetition period as that

of an information symbol period (hereinafter, a code which has the same repetition period as the information symbol period will be called a short code) and a second spreading code group which has a longer repetition period than the information symbol period (hereinafter, a code which has a longer repetition period than the information symbol period will be called a long code) are used. A signal is transmitted by spreading doubly with a first spreading code of the first spreading code group and a second spreading code of the second spreading code group (here, the second spreading code varies from one base station to another). The second spreading code is used in order to reduce interference from other base stations since the number of first spreading code of the first spreading code group is limited.

[0003]

In a wireless mobile communication system, a mobile station communicates with a telephone terminal in a public network or the like via a wireless base station. A wireless circuit can be easily listened in on or used fraudulently since the circuit is open to the air. Hence, there have been various technologies conventionally which enable a mobile station to connect to only a specific base station in order to avoid others listening in or a fraudulent use.

[0004]

For example, Japanese laid-open patent application No.63-189026 discloses an invention of a cordless telephone system such as a normal domestic cordless telephone. In the cordless telephone, a cordless handset and a cordless base transmit/receive a unique system identifying number such that a cordless base which can communicate with a cordless handset is identified. Communication is allowed only when the system identifying number of the cordless base matches with the system identifying number of the cordless handset.

[0005]

As another example, Japanese laid-open patent application No.7-203540 discloses an invention regarding a business cordless telephone system which provides a roaming service for a terminal which moves in a wireless service area of a PBX. In the conventional example, a cordless handset stores a plurality of unique system identifying numbers which are assigned to each system which numbers can be communicated, or the cordless handset stores a network identifying number which indicates a plurality of system identifying numbers which can be communicated by the cordless handset. When communicating, the cordless handset identifies a cordless base which can communicate with the cordless handset by transmitting/receiving the identifying numbers. That is, when the system identifying numbers or the network identifying numbers of the cordless handset and the cordless base are the same, the cordless handset and the cordless base can communicate with each other.

[0006]

[Problems to be Solved by the Invention]

Generally, a control for determining whether a base station and a mobile station are allowed to connect should be carried out as quickly as possible, since the control is a preparation.

By the way, if the above conventional methods are applied as is to the direct sequence CDMA mobile communication system, the mobile station needs to receive and recognize the system identifying number or the network identifying number. For that purpose, the mobile station needs to know a spreading code (a long code or a short code) which the base station uses. After despreading a received signal with the spreading code, the mobile station can know the system identifying number or the network identifying number from an information symbol.

In this case, if the spreading code is not known beforehand, it is necessary to identify the spreading code. Therefore, it takes much time for the mobile station to determine whether the mobile station can connect to the base station from the received signal. Thus, the above-mentioned methods are not practical.

[0007]

On the other hand, in the direct sequence CDMA mobile communication system, a different second spreading code, which is a different long code, for each base station is used. However, when the direct sequence CDMA mobile communication system is applied to a small mobile communication system such as a cordless telephone system and the like, the different second spreading code is not necessarily required for each base station.

The present invention is achieved in view of the above-mentioned finding. An objective of the present invention is to provide a direct sequence CDMA mobile communication system where an assignment method of the second spreading code is devised such that interference between cordless systems can be avoided and a roaming service can be provided.

[0008]

[Means to Solve the Problems]

The invention described in claim 1 is a signal transmitting method in a direct sequence CDMA mobile communication system for transmitting a signal after spreading the signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, the first spreading code having the same repetition period as an information symbol period, the second spreading code having a longer repetition period than the information symbol period, the first spreading code

and the second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of the spreading codes being higher than an information rate; wherein the second spreading code is associated with a mobile communication system; and a base station transmits a signal spread by the second spreading code associated with a mobile communication system to which the base station belongs.

[0009]

According to the invention described in claim 1, second spreading codes are associated with mobile communication systems, and the base station transmits a signal spread by the second spreading code associated with a mobile communication system to which the base station belongs. With this configuration, the spreading code itself functions as a cordless telephone system identifying number. Therefore, a cordless handset does not have to check the cordless telephone system identifying number after identifying the spreading code used for dispreading. This makes it possible for a cordless handset to easily identify a cordless base that can communicate with the cordless handset. Also, the cordless handset cannot communicate with a cordless base in a different cordless telephone system because the second spreading codes are different. Thus, the configuration of claim 1 makes it possible to prevent interference from other cordless telephone systems.

[0010]

According to the invention described in claim 2, in the signal transmitting method in a direct sequence CDMA mobile communication system as claimed in claim 1, instead of a second spreading code associated with a mobile communication system, a second spreading code associated with a network type to which the mobile communication system belongs is used as the second spreading code.

[0011]

The invention described in claim 2 makes it possible to provide a roaming service by just assigning a second spreading code associated with a network type to which a mobile communication system belongs to a cordless base and a cordless handset.

The invention described in claim 3 is a spreading code assigning method in a direct sequence CDMA mobile communication system for transmitting a signal after spreading the signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, the first spreading code having the same repetition period as an information symbol period, the second spreading code having a longer repetition period than the information symbol period, the first spreading code and the second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of the spreading codes being higher than an information rate. The spreading code assigning method includes the step of assigning a code associated with a mobile communication system or a network type to which the mobile communication system belongs as the second spreading code.

[0012]

The invention described in claim 3 defines a method of assigning a second spreading code in a direct sequence CDMA mobile communication system.

The invention described in claim 4 is a base station in a direct sequence CDMA mobile communication system for transmitting a signal after spreading the signal doubly with a first spreading code in a first spreading code group and a second spreading code in a second spreading code group, the first spreading code having the same repetition period as an information symbol period, the second spreading code having

a longer repetition period than the information symbol period, the first spreading code and the second spreading code forming spreading codes for enlarging a band of a wide-band signal, a rate of the spreading codes being higher than an information rate. The second spreading code is associated with a mobile communication system or a network type to which the mobile communication system belongs; and the base station is configured to transmit a signal spread by the second spreading code associated with a mobile communication system to which the base station belongs or by the second spreading code associated with a network type to which the mobile communication system belongs.

[0013]

The invention described in claim 4 defines a base station in a direct sequence CDMA mobile communication system.

The invention described in claim 5 is a mobile station in a direct sequence CDMA mobile communication system for receiving a signal transmitted from the base station by the signal transmitting method in the direct sequence CDMA mobile communication system as claimed in claim 1 or 2. The mobile station includes the second spreading code associated with one or more mobile communication systems or the second spreading code associated with a network type to which the one or more mobile communication systems belong, and is configured to receive the signal transmitted from the base station by using the second spreading code.

[0014]

The invention described in claim 5 defines a mobile station in a direct sequence CDMA mobile communication system.

[0015]

[Advantages of the Invention]

[0015]

[Embodiments of the Invention]

In the following, embodiments of the present invention will be described with reference to figures. FIG. 1 shows a configuration example of the direct sequence system used in general. In the system, received information is first-spread with a first spreading code. After that, the received information is second-spread with a second spreading code. Information which is applied to an input terminal 1 is first-spread in a multiplier 2 by multiplying the information by an output from a first spreading code generator 3. Next, a spreading output from the multiplier 2 is multiplied by an output from a second spreading code generator 5 such that second-spreading is performed and a spread modulation signal output is obtained at an output terminal 6.

[0016]

Here, an orthogonal code (for example, a GOLD code) is used as the first spreading code generally. The number of the orthogonal codes which are generated is limited to the number of a spreading ratio. Therefore, in a general direct sequence CDMA communication system, a signal is spread and transmitted with the second spreading code having a longer repetition period than the information symbol period as well as the first spreading code having a repetition period of the information symbol period. The second spreading code having the longer repetition period can have a large number of spreading codes by highly increasing the repetition period.

(1) First embodiment of the present invention

FIG. 2 shows an example of a correspondence between system identifying numbers and second spreading codes. Conventionally, the second spreading code is assigned to each base station. On the other hand, in the example shown in FIG.

6, the second spreading code is assigned to each base station group. A mobile communication system such as a cordless telephone system and the like can be taken as an example of the base station group. That is, when there are a plurality of cordless telephone systems in a house, the second spreading code is assigned to each cordless telephone system. Therefore, in this case, cordless bases in the same cordless telephone system use the same second spreading code so as to second-spread a transmitting signal and send the signal to cordless handsets.

[0017]

FIG. 2 shows an example in which the second spreading codes are assigned to three cordless telephone systems. That is, a second spreading code 101010101010 is assigned to a cordless telephone system 1111, a second spreading code 010101010101 is assigned to a cordless telephone system 2222, a second spreading code 000000111111 is assigned to a cordless telephone system 3333.

[0018]

In the first embodiment of the present invention, the cordless base sends a signal after spreading the signal with a second spreading code assigned to a cordless telephone system to which the cordless base belongs. For example, a cordless base of the cordless telephone system having a system identifying number 1111 multiplies information received from the input terminal 1 by an output from the first spreading code generator 3 at the multiplier 2 so as to first-spread the information. Next, a spreading output from the multiplier 2 is second-spread by the multiplier 4 with a second spreading code 101010101010 associated with the system identifying number 1111 assigned to the cordless telephone system to which the cordless base belongs, and then a spread modulation signal output which should be transmitted to a cordless handset is

obtained at the output terminal 6.

[0019]

On the other hand, a cordless handset uses a second spreading code assigned to a cordless telephone system to which the cordless handset belongs. For example, the cordless handset in the cordless telephone system having the system identifying number 1111 use the same second spreading code 101010101010. The cordless handset processes a spread modulation signal input sent from the cordless base by a circuit as shown in FIG. 5. A spread modulation signal input appearing at a line 30 is correlated by an output of a communication channel orthogonalizing first spreading code replica generating unit 22 and a matched filter 21. The maximum value of an output from the matched filter 21 is detected by a maximum correlation output detecting circuit 23 and a timing of a peak value of the correlation detection output is detected by a maximum correlation peak chip phase detecting circuit 24. Next, a second spreading code replica generating unit 25 is triggered by the peak value output of the maximum correlation peak chip phase detecting circuit 24 to generate a second spreading code. The second spreading code and the spread modulation signal input appearing at a line 31 are multiplied together by a multiplier 26, and its correlation is detected by an integration and dump circuit 27. Then, a threshold determining circuit 28 determines whether the output from the integration and dump circuit 27 is greater than a threshold.

[0020]

As mentioned-above, the cordless base and the cordless handset use the same second spreading code assigned to the cordless telephone system to which the cordless base and the cordless handset belong. Thus, when a cordless base and a cordless handset belong to the same cordless telephone system,

the second spreading code with which the cordless base spreads a signal and the second spreading code used by the cordless handset are the same. Therefore, the cordless handset can receive a signal. Since a spreading code in itself functions as an identifying number of a cordless telephone system, the cordless handset does not need to check the identifying number of the cordless telephone system after identifying a spreading code for despreading. Thus, the cordless handset can identify easily a cordless base with which the cordless handset can communicate.

[0021]

In addition, the cordless handset can not communicate with a cordless base of another cordless telephone system. Therefore, interference from other cordless telephone systems can be avoided.

(2) Second embodiment of the present invention

In the first embodiment, the second spreading code is assigned to each cordless telephone system. On the other hand, in a second embodiment of the present invention, the second spreading code is assigned to a unit in which a plurality of cordless telephone systems exist. (The unit including a plurality of systems is called "a network type". That is, each network type includes one or more systems.) In other words, when there are a plurality of cordless telephone systems in a house, the second spreading code is assigned to each network type. Therefore, in this case, when cordless bases of different cordless telephone systems belong to the same network type, the cordless bases can second-spread a signal with the same second spreading code and transmit the signal.

[0022]

FIG. 4 shows an example of a correspondence between system identifying numbers, network identifying numbers and

second spreading codes. The network identifying number is an identifying number assigned to each of the above-mentioned network types. FIG. 4 shows an example in which second spreading codes are assigned to three cordless telephone systems. Each cordless telephone system has a network identifying number associated the network type. A cordless telephone system 1111 and a cordless telephone system 2222 belong to the same network type and have the same network identifying number 12345678. A cordless telephone system 3333 has a network identifying number 87654321.

[0023]

In addition, the second spreading code is assigned in correspondence with the network identifying number. A second spreading code 101010101010 is assigned to the network identifying number 12345678 and a second spreading code 000000111111 is assigned to the network identifying number 87654321.

In the second embodiment of the present invention, a cordless base spreads a signal with a second spreading code assigned to a network identifying number of a cordless telephone system to which the cordless base belongs. For example, a cordless base which has the system identifying number 1111 first-spreads information received from the input terminal 1 by multiplying the information by an output from the first spreading code generator 3 at the multiplier 2. Next, the cordless base second-spreads the spreading output from the multiplier 2 at the multiplier 4 with a second spreading code 101010101010 associated with the network identifying number, and obtains a spread modulation output at the output terminal 6. Similarly, a cordless base which has the system identifying number 2222 first-spreads information received from the input terminal 1 by multiplying the information by an output from the first spreading code generator 3 at the

multiplier 2. Next, the cordless base second-spreads the spreading output from the multiplier 2 at the multiplier 4 with a second spreading code 101010101010 associated with the network identifying number, and obtains a spread modulation output at the output terminal 6.

[0024]

The configuration of a reception circuit of a cordless handset in the above case is substantially the same as that shown in FIG. 5 except that the second spreading code is associated with the network identifying number. When a cordless handset moves to a zone of another cordless telephone system, the cordless handset can continue to perform a communication if the other cordless telephone system has the same network identifying number as that of the cordless telephone system to which the cordless handset originally belongs.

[0025]

For example, when a cordless handset in the cordless telephone system 1111 moves to a zone of the cordless telephone system 2222, the cordless handset can continue to perform a communication since the network identifying numbers are the same and the second spreading codes from cordless bases are the same. However, when a cordless handset in the cordless telephone system 1111 moves to a zone of the cordless telephone system 3333, the cordless handset can not continue to perform a communication since the second spreading codes from the cordless bases are different.

[0026]

Thus, in the direct sequence CDMA cordless telephone system, a roaming service can be provided only by assigning the second spreading code associated with the network identifying number of a cordless telephone system to which a cordless base belongs.

(3) Third embodiment of the present invention (a variation of the first embodiment)

The roaming service described in the first embodiment can also be provided in such a way that a cordless handset has a plurality of second spreading codes associated with cordless telephone systems which obtain the roaming service.

[0027]

For example, when a cordless handset in the cordless telephone system 1111 moves to a zone of the cordless telephone system 2222, the cordless handset can continue to perform a communication if it has the second spreading code 010101010101 of the cordless telephone system 2222.

In this case, for example, the cordless handset processes a spread modulation signal input sent from the cordless base by a circuit as shown in FIG. 6. The spread modulation signal input sent from the cordless base and appearing at a line 50 is correlated by an output of a communication channel orthogonalizing first spreading code replica generating unit 42 and a matched filter 41. The maximum value of an output from the matched filter 41 is detected by a maximum correlation output detecting circuit 43 and a timing of a peak value of the correlation detection output is detected by a maximum correlation peak chip phase detecting circuit 44. Next, a second spreading code replica generating unit 45 is triggered by the peak value output of the maximum correlation peak chip phase detecting circuit 44 to generate a second spreading code. The second spreading code and the spread modulation signal input appearing at a line 51 are multiplied together by a multiplier 46, and its correlation is detected by an integration and dump circuit 47. Then, a threshold determining circuit 48 determines whether the output from the integration and dump circuit 27

is greater than a threshold. If the output is greater than the threshold, the output is sent to a demodulation/RAKE combining circuit to obtain a received signal. If the output is equal to or less than the threshold, the phase of the second spreading code replica generating unit 75 is shifted and the second spreading code of another cordless telephone system retained in the cordless handset is generated to detect the correlation. If no correlating output is obtained based on all second spreading codes, it is determined that the cordless handset is out of communication range or in a zone where the roaming service is not available.

[0028]

[Advantages of the Invention]

Thus, the present invention provides various advantageous effects as described below.

According to the invention described in claim 1, second spreading codes are associated with mobile communication systems, and the base station transmits a signal spread by the second spreading code associated with a mobile communication system to which the base station belongs. With this configuration, the spreading code itself functions as a cordless telephone system identifying number. Therefore, a cordless handset does not have to check the cordless telephone system identifying number after identifying the spreading code used for dispreading. This makes it possible for a cordless handset to easily identify a cordless base that can communicate with the cordless handset. Also, the cordless handset cannot communicate with a cordless base in a different cordless telephone system because the second spreading codes are different. Thus, the configuration of claim 1 makes it possible to prevent interference from other cordless telephone systems.

[0029]

The invention described in claim 2 makes it possible to provide a roaming service by just assigning a second spreading code associated with a network type to which a mobile communication system belongs to a cordless base and a cordless handset.

The invention described in claim 3 provides a method of assigning a second spreading code in a direct sequence CDMA mobile communication system that makes it possible to prevent interference between cordless systems and thereby makes it possible to provide a roaming service.

[0030]

The invention described in claim 4 provides a base station in a direct sequence CDMA mobile communication system that makes it possible to prevent interference between cordless systems and thereby makes it possible to provide a roaming service.

The invention described in claim 5 provides a mobile station in a direct sequence CDMA mobile communication system that makes it possible to prevent interference between cordless systems and thereby makes it possible to provide a roaming service.

[Brief Description of the Drawings]

FIG. 1 shows an exemplary configuration of a direct sequence system;

FIG. 2 shows an example of a correspondence between system identifying numbers and second spreading codes;

FIG. 3 shows an exemplary configuration of a roaming service between PBXs;

FIG. 4 shows an example of a correspondence between system identifying numbers, network identifying numbers and second spreading codes;

FIG. 5 shows a part of a reception circuit of a cordless handset (1); and

FIG. 6 shows a part of a reception circuit of a cordless handset (2).

[Description of the Reference Numerals]

1 Information input terminal

2, 4, 26 Multiplexer

3 First spreading code generating unit

5 Second spreading code generating unit

21, 41 Matched filter

22, 42 Short code replica generating unit

23, 43 Maximum correlation output detecting circuit

24, 44 Maximum correlation peak chip phase detecting circuit

25, 45 Long code replica generating unit

27, 47 Integration and dump circuit

28, 48 Threshold determining circuit

[Name of the Document] Abstract

[Abstract]

[Object] An object of the present invention is to provide a direct sequence CDMA mobile communication system where an assignment method of the second spreading code is devised such that interference between cordless systems can be avoided and a roaming service can be provided.

[Solution Means] The object can be achieved by assigning a second spreading code to each cordless telephone system. For example, a second spreading code 101010101010 is assigned to a cordless telephone system 1111. A codeless base of the cordless telephone system having a system identifying number 1111 transmits a signal using the second spreading code 101010101010. A cordless handset with the system identifying number 1111 has the second spreading code 101010101010 and therefore can receive the spread modulation signal from the cordless base. Meanwhile, the cordless handset cannot communicate with cordless bases of other cordless telephone systems because they have different second spreading codes.

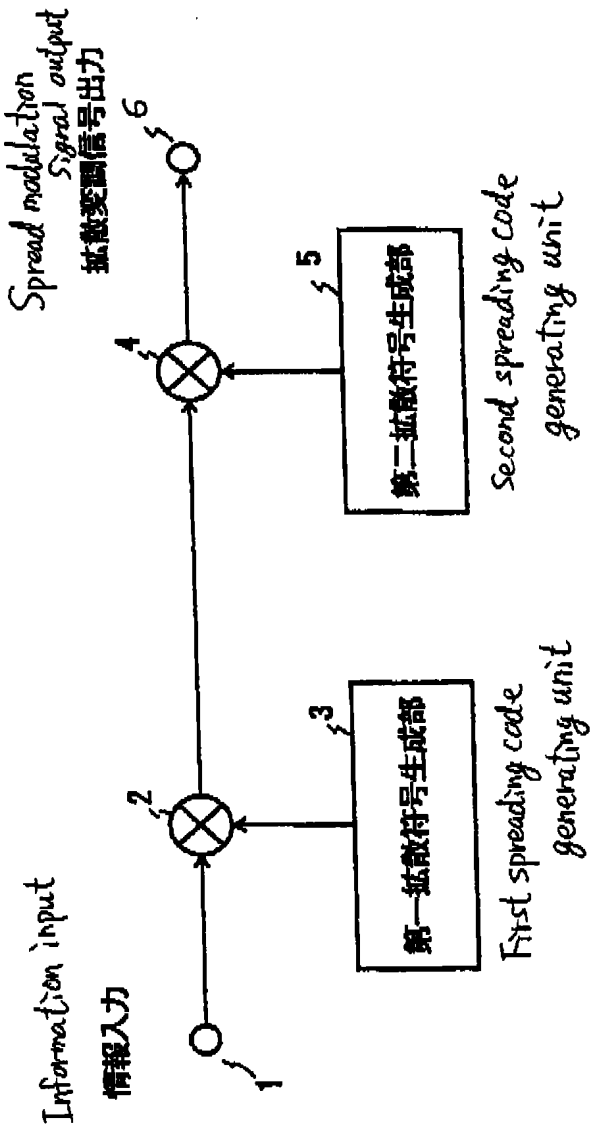
[Selected Figure] FIG. 2

【書類名】 図面 Figures

【図１】 FIG. 1

Exemplary configuration of direct sequence system

直接拡散方式の構成例を示す図



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【図２】 FIG. 2

Correspondence between system identifying numbers and second spreading codes

システム識別番号と第二拡散符号の対応関係の例を示す図

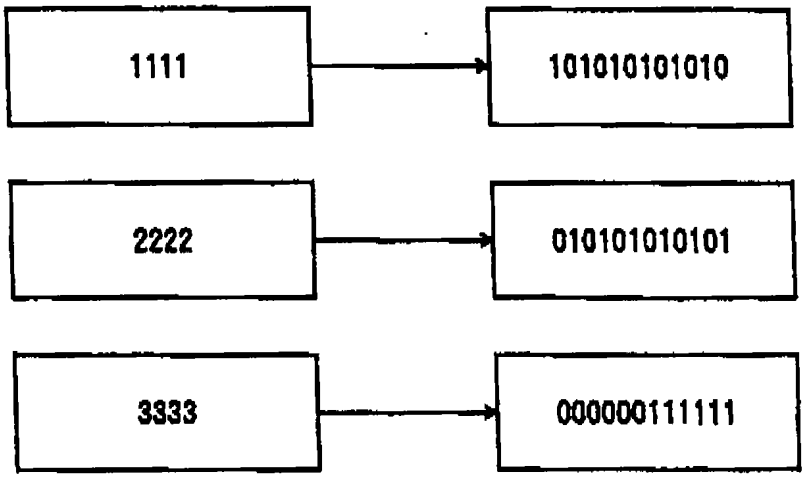
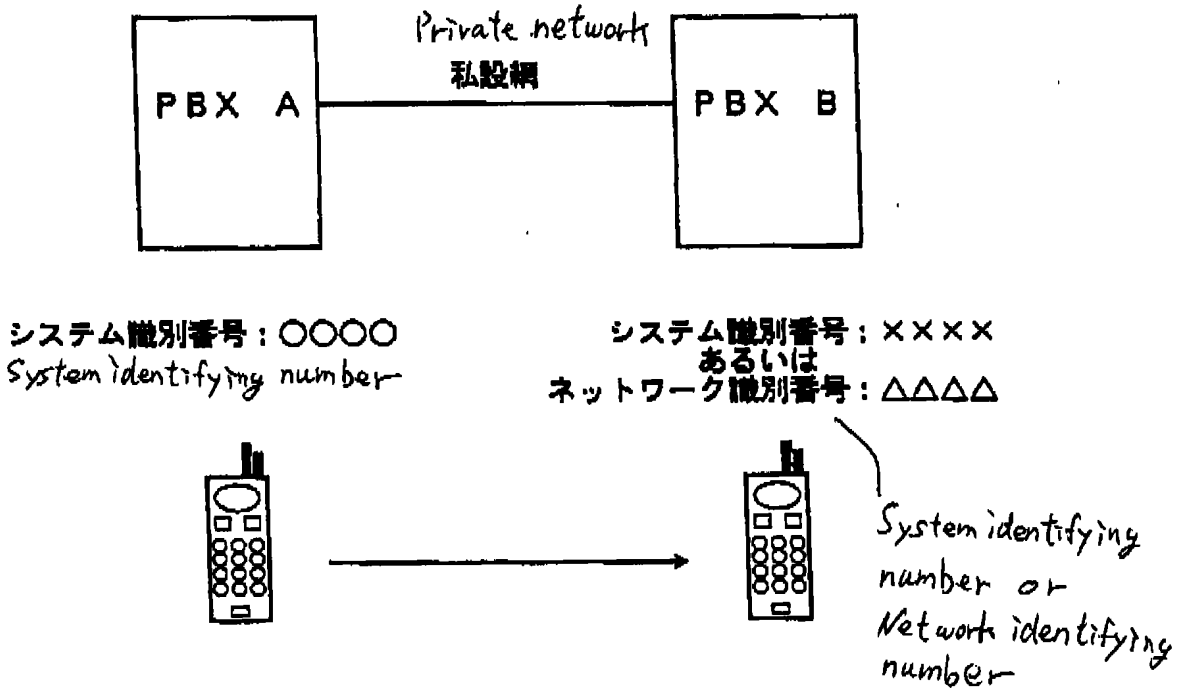


Fig 6

【図３】 FIG.3

Exemplary configuration of roaming service between PBXs

ＰＢＸ間ローミングサービスの構成例を示す図

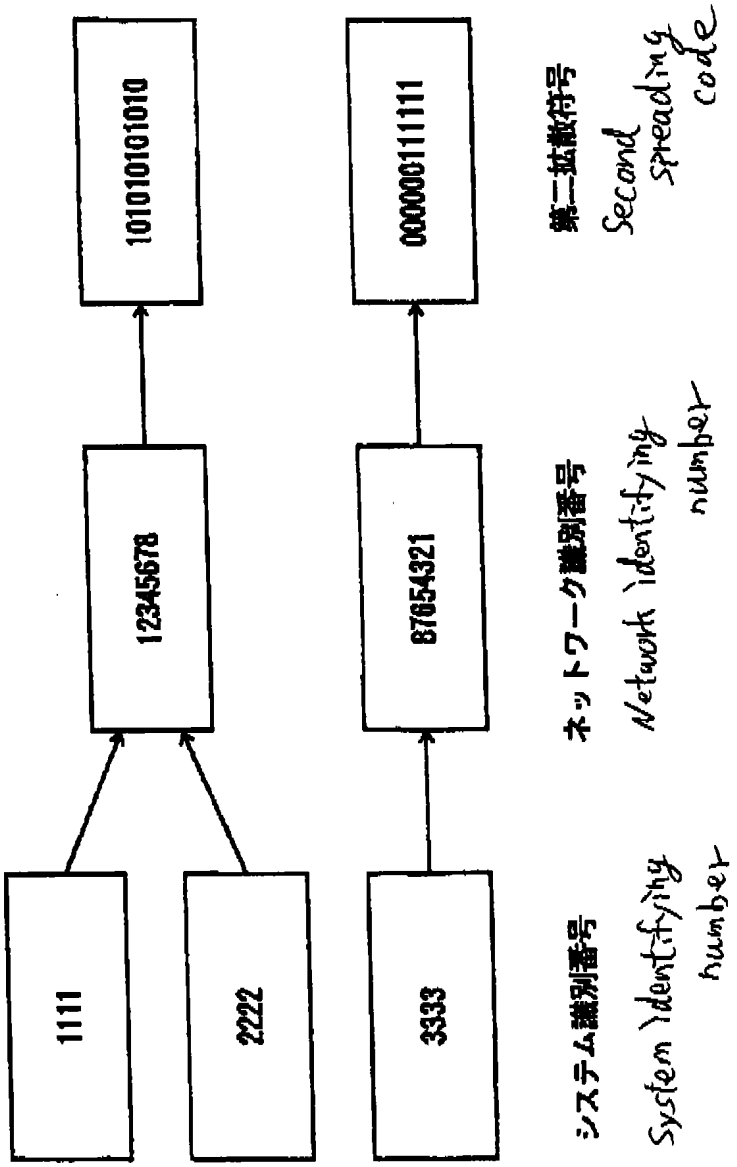


以上

【図４】 FIG. 4

Correspondence between system identifying numbers, network identifying numbers, and second spreading codes

システム識別番号とネットワーク識別番号及び第二拡散符号の対応関係の例を示す図



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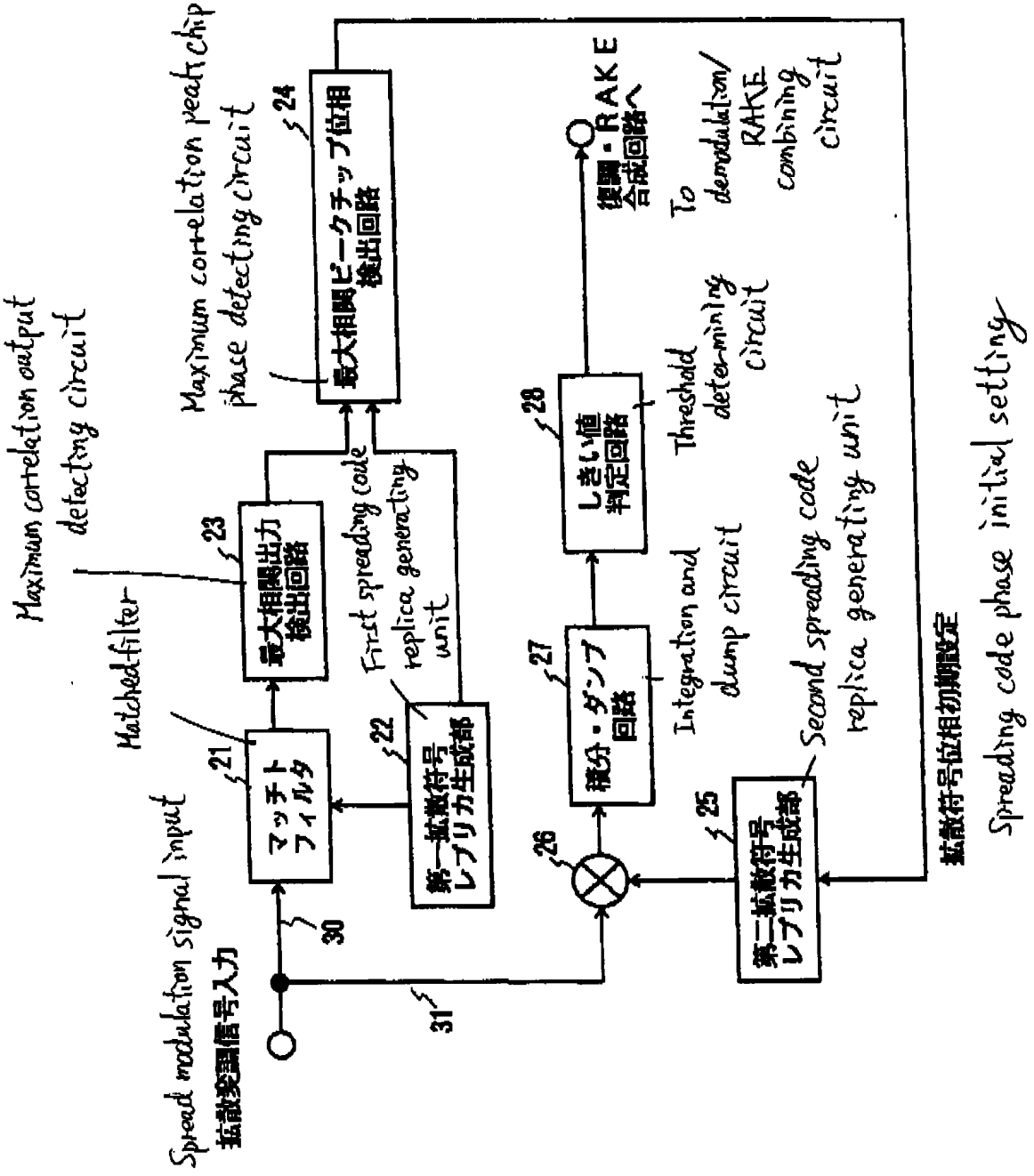
【図５】 FIG.5

Part of reception circuit of codeless handset (1)

コードレス子機の受信回路の一部を説明するための図（その１）



【図６】 FIG. 6

Part of reception circuit of codeless handset (2)

コードレス子機の受信回路の一部を説明するための図（その２）